Space Weather Technical Forecast

Issued on Saturday, 17 August 2024 at 01:23 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: G1-G2 Likely day 1 UTC day of Saturday 17 August. R1/R2 Expected throughout, Slight Chance R3.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was Moderate, with an M1.3 flare at 16/1324UTC from the vicinity of off-going AR3780. There are up to 13 sunspot regions on the visible disc. The largest spot remains AR3784 in the northwestern quadrant, which comprises a large Mt Wilson delta spot, with an east-west magnetic neutral line. AR3780 on the southwest limb is suffering from significant foreshortening effects, now only partially visible, therefore it's previously large and complex classification is preserved. The spot group in the southeast quadrant (AR3790/AR3791/AR3792) have been analysed as separate spots, with AR3790 showing proliferation of intermediate spots and a slight growth trend. AR3792 has emerged around the the southeast limb as a large and stable unipolar spot. Otherwise most other spots are small and simplifying, with the only exceptions being AR2785 to the south and AR3789 to the north both near centre disk, each showing a slight growth trend due to proliferation of intermediate spots.

Although several CMEs have been observed leaving the sun in the period, after analysis, none have been deemed to be Earth-directed.

Solar Wind / Geomagnetic Activity: Solar winds, as measured by ACE at L1 were reflective of a slow regime. The solar wind speed fluctuated from about 360km/s to 300km/s. The solar wind density was a little more erratic than is typical, with mainly single figure ppcc values but occasionally reaching 17ppcc in the middle of the UTC day. The IMF, Bt was weak, below 7nT, while the north-south component moved from mostly negative to mostly positive, with peak values ranging between -5nT and +6nT. The phi angle showed a slow drift from negative (towards the Sun) to positive (away from the Sun), with the SSBC observed around 16/1200UTC. The net result of the above solar wind measures was Quiet to Unsettled (Kp 1-3) geomagnetic indices.

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux observed by GOES18 remained at Background levels.

High energy electron flux (greater than 2MeV) observed at GOES16 was at Moderate to Normal Background, with an approximate peak of 177pfu at 16/1355UTC. The 24-hour fluence was below the Active threshold, with 1.59e6 integrated pfu observed at 17/0001UTC, on a declining trend.

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate activity is Expected, with a daily Slight Chance of isolated X-class flares, mostly from AR3784 in the northwest. This risk is judged constant throughout, with significant departing regions (AR3780) perhaps in some way compensated for by the weight of numbers of east limb arrivals.

Solar Wind /Geomagnetic Activity: A faint, partial halo CME occurred due to the X1.1 flare at 14/0640UTC, and is forecast to arrive at Earth day 1 (Saturday 17 August). The strength of this is low confidence, with the main geomagnetic activity likely with any subsequent magnetic cloud. This has

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the potential to be further enhanced by the fast wind of CH58/- on the north-disc, however in itself this is most likely to remain north of the ecliptic. Mainly Quiet geomagnetic activity is therefore expected at first, giving way to Likely G1/G2 Minor to Moderate Storm on day 1 (Saturday 17 August) due to the X1.1 CME arrival. There is a Slight Chance of this event reaching G3 Strong (Kp 7) Storm. Activity should then revert to Quiet over the course of day 2 (Sunday 18 August).

Energetic Particles / Solar Radiation: High energy proton flux is most likely to remain at Background, but with a Chance of breaching S1 Minor solar radiation storm level should any notable flares occur from either AR3780 on the western limb or AR3784 in the northwest.

The high energy electron flux is forecast to continue its current subdued diurnal oscillation, with the 24-hour fluence remaining below the Active threshold (1e8 integrated pfu). Confidence in this state of affair's continuation falls in the wake of the CME.

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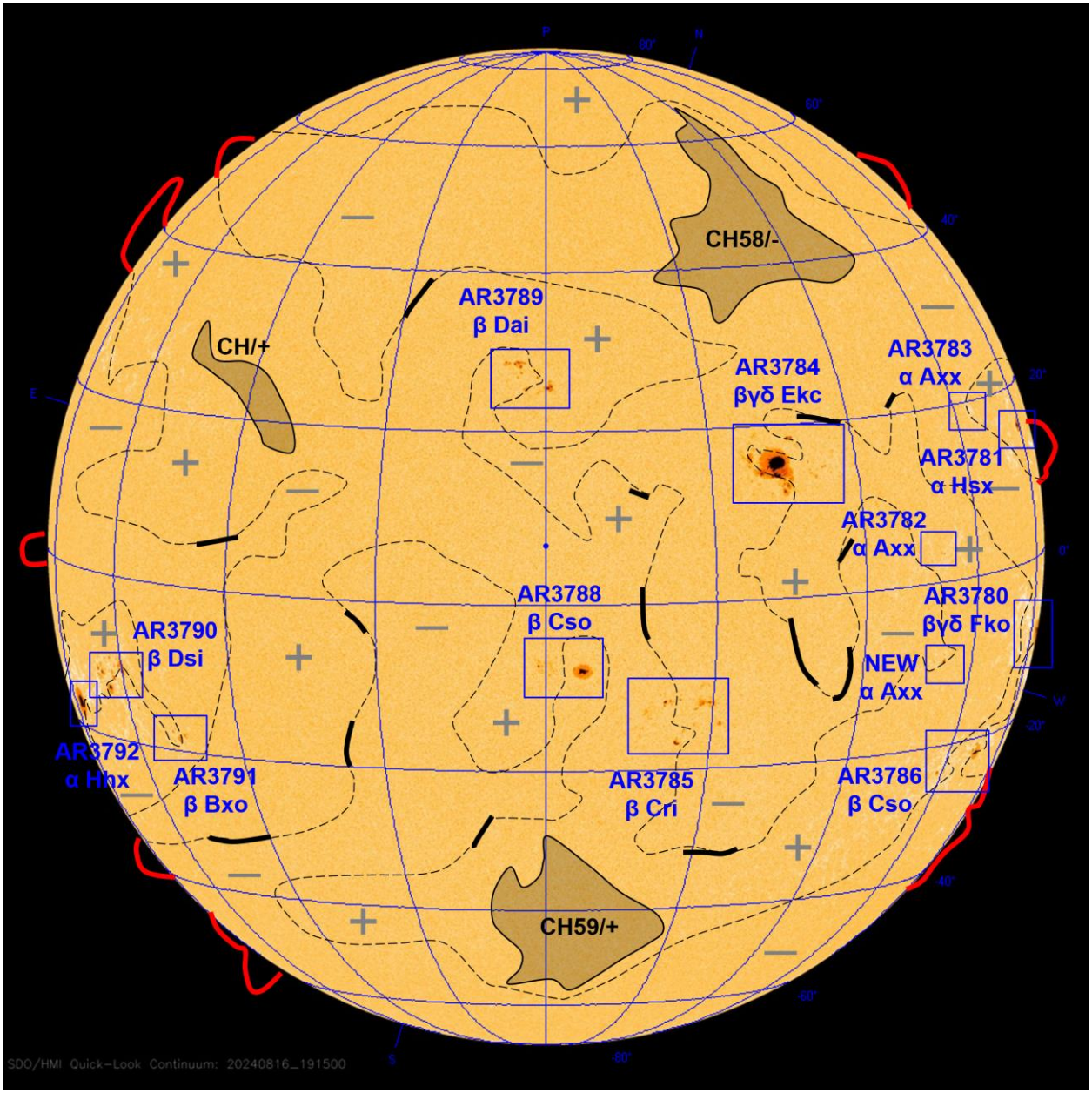
Figure 1. Solar Analysis Valid 16/1915UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Met Office Space Weather Technical Forecast

Geomagnetic Storms:

No fast winds (directly) feature in the four-day forecast and only one CME.

This CME was visible as a faint, partial halo CME associated with the X1.1 flare at 14/0640UTC. This has been assessed as having an Earth-directed component, most likely arriving at Earth during the first half of day 1 (17 Aug). Given the relatively slow speed of the CME, the initial (shock) impact may be rather limited, with the majority of the geomagnetic activity most likely with the subsequent magnetic cloud, but still likely peaking within the first half of the UTC weekend. This CME is likely to have interacted with the fast wind emanating from negative polarity coronal hole 58 en route to Earth, and while the most likely case is that the fast wind itself should pass north of the ecliptic plane (as on last pass), this is marginal. Earth is very slightly further above the solar equatorial plane on this rotation relative to last (making northern solar hemisphere features potentially more aligned), however the feature is of a less well-connecting polarity at this stage of the cycle, and the fast wind persists in remaining north of Earth on the latest MOSWOC Enlil runs.

Initial Quiet geomagnetic activity should rise to Likely G1/G2 on Saturday 17 August, with a gradual tailing off then expected later in the UTC weekend to leave the new working week Quiet once again. There is a Slight Chance of G3 Strong geomagnetic storm activity owing to complications in the analysis (pollution of the halo from a northwest limb CME) and also any low confidence interaction with a large and presumably intense (from EUV appearances) coronal hole on the northwest disc.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	70	40	1	1
Strong	G3	No	15	5	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
14/1400	Full	X1.1 flare	N Centre	610 km/s	17/0800UTC +/-6hrs	High probability of arrival, lower confidence for exact timing.

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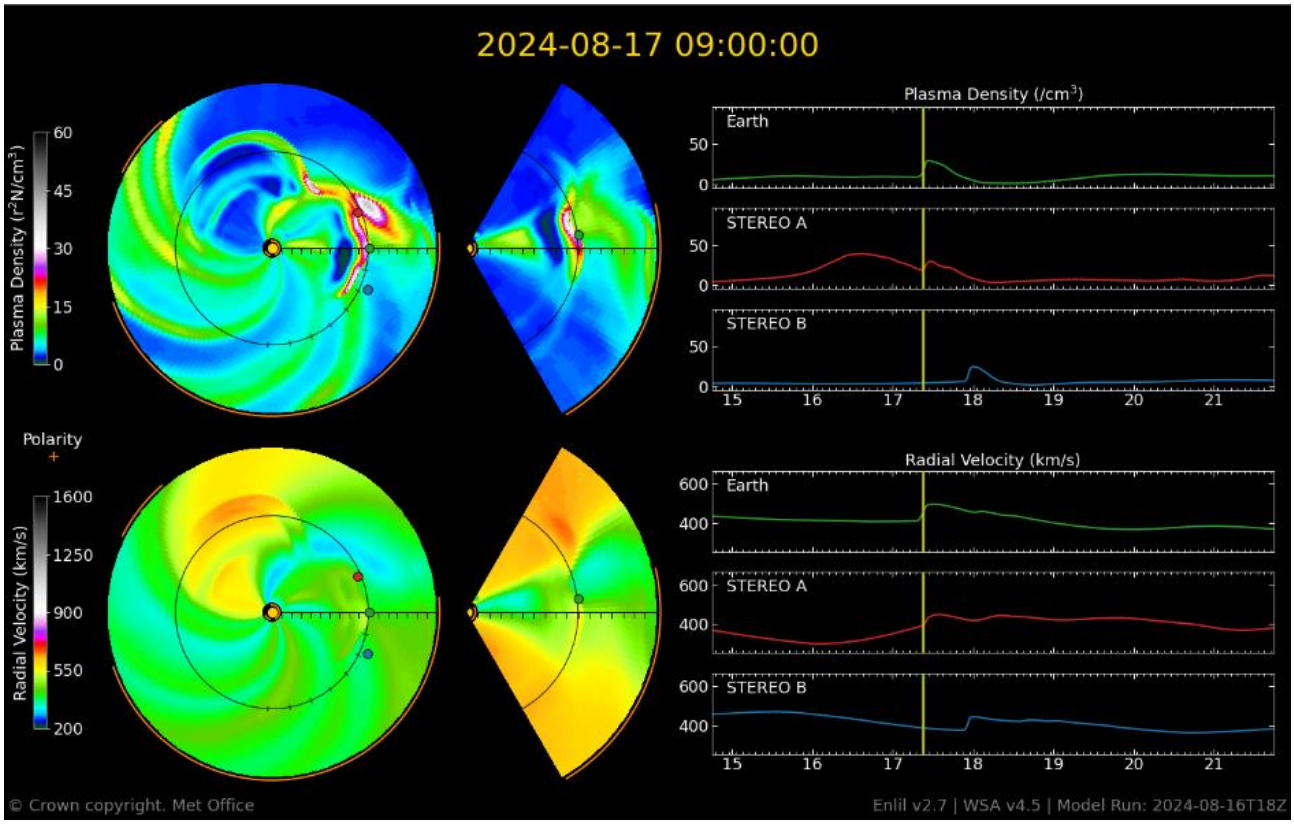
Figure 2: MOSWOC ENLIL



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Radio Blackouts - X-Ray Flares:

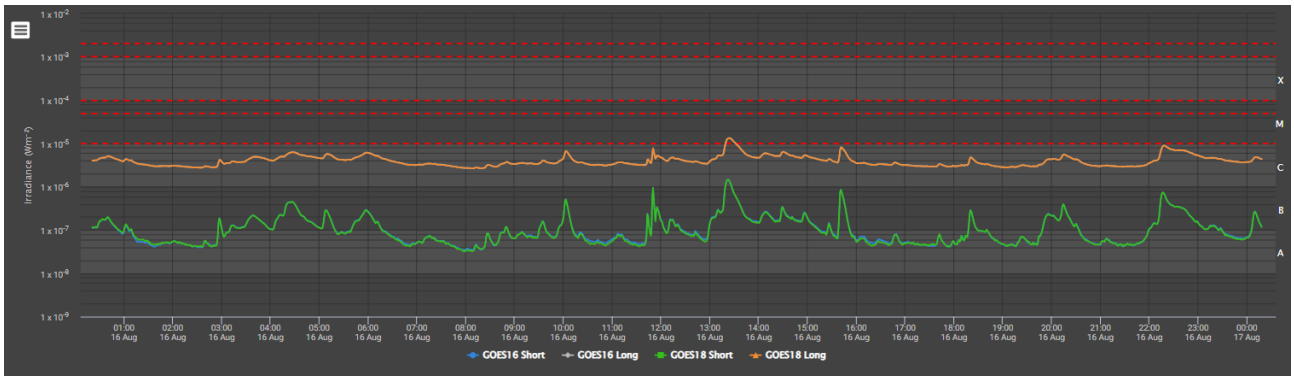
Solar activity rose to Moderate, with an M1.3 flare at 16/1324UTC from the vicinity of off-going AR3780.

There are up to 13 sunspot regions on the visible disc. The largest spot remains AR3784 in the northwestern quadrant, which comprises a large Mt Wilson delta spot, with an east-west magnetic neutral line and consequent shear by differential rotation. Intermediate spot growth to the northwest has been observed in recent hours, otherwise this spot appears to be relatively unchanged. AR3780 on the southwest limb is suffering from significant foreshortening effects, now only partially visible, therefore it's previously large and complex classification is preserved. The spot group in the southeast quadrant (AR3790/AR3791/AR3792) have been analysed as separate spots, with AR3790 showing proliferation of intermediate spots and a slight growth trend. AR3792 has emerged around the the southeast limb as a large and stable unipolar spot. Otherwise most other spots are small and simplifying, with the only exceptions being AR2785 to the south and AR3789 to the north both near centre disk, each showing a slight growth trend due to proliferation of intermediate spots.

A significant risk of M-class flares persists, with these remaining Expected as a result of two complex regions, and there is also a Slight Chance of X-class. The departure of AR3780 onto the far side into the UTC weekend would normally herald a reduction in daily probabilities of significant flares, however there are numerous returning Carringtons of past regions also populating the eastern limb which maintains the daily risks of flares.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	80	80	80	80
Very Active	R3 to R5 X Class	No	20	20	20	20

Figure 3: 24 hour X-ray trace



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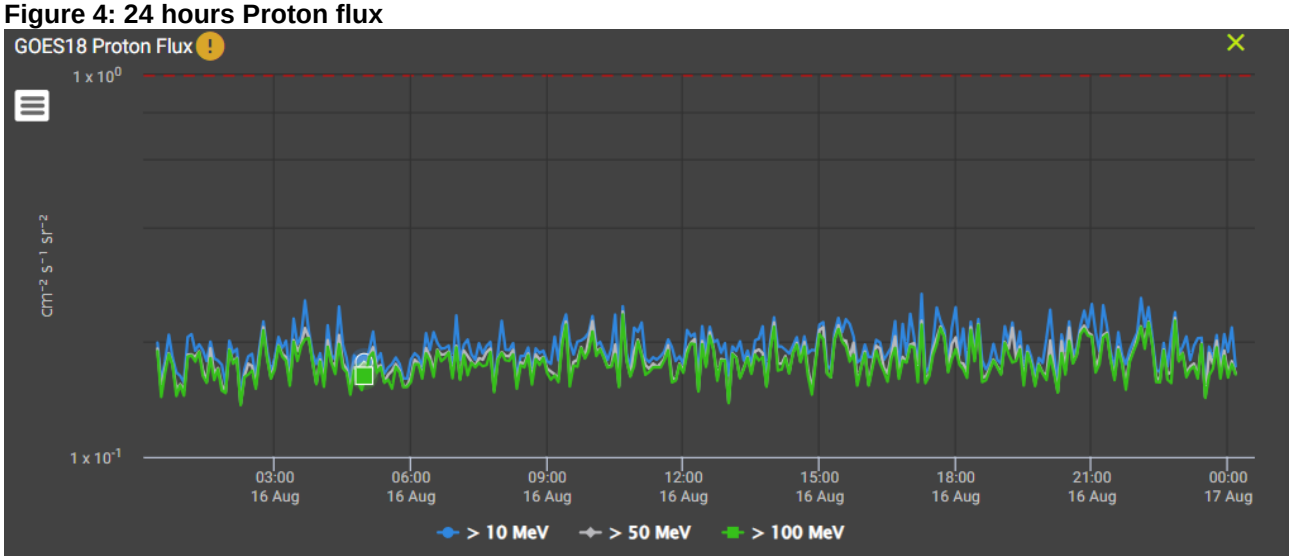
Solar Radiation Storms - (High Energy Protons):

The daily risk of solar radiation storms will remain at a slight chance as AR3780 is superseded by AR3784 as the former spot rotates around the western limb and the latter rotates into an increasingly geoeffective longitude for proton-rich events should any notable flares occur. On the contrary, there has yet to be any evidence of these events despite some relatively large flares.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	20	20	20	20
Very Active	**≥ S3 ***	No	5	5	5	5

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

Figure 4: 24 hours Proton flux



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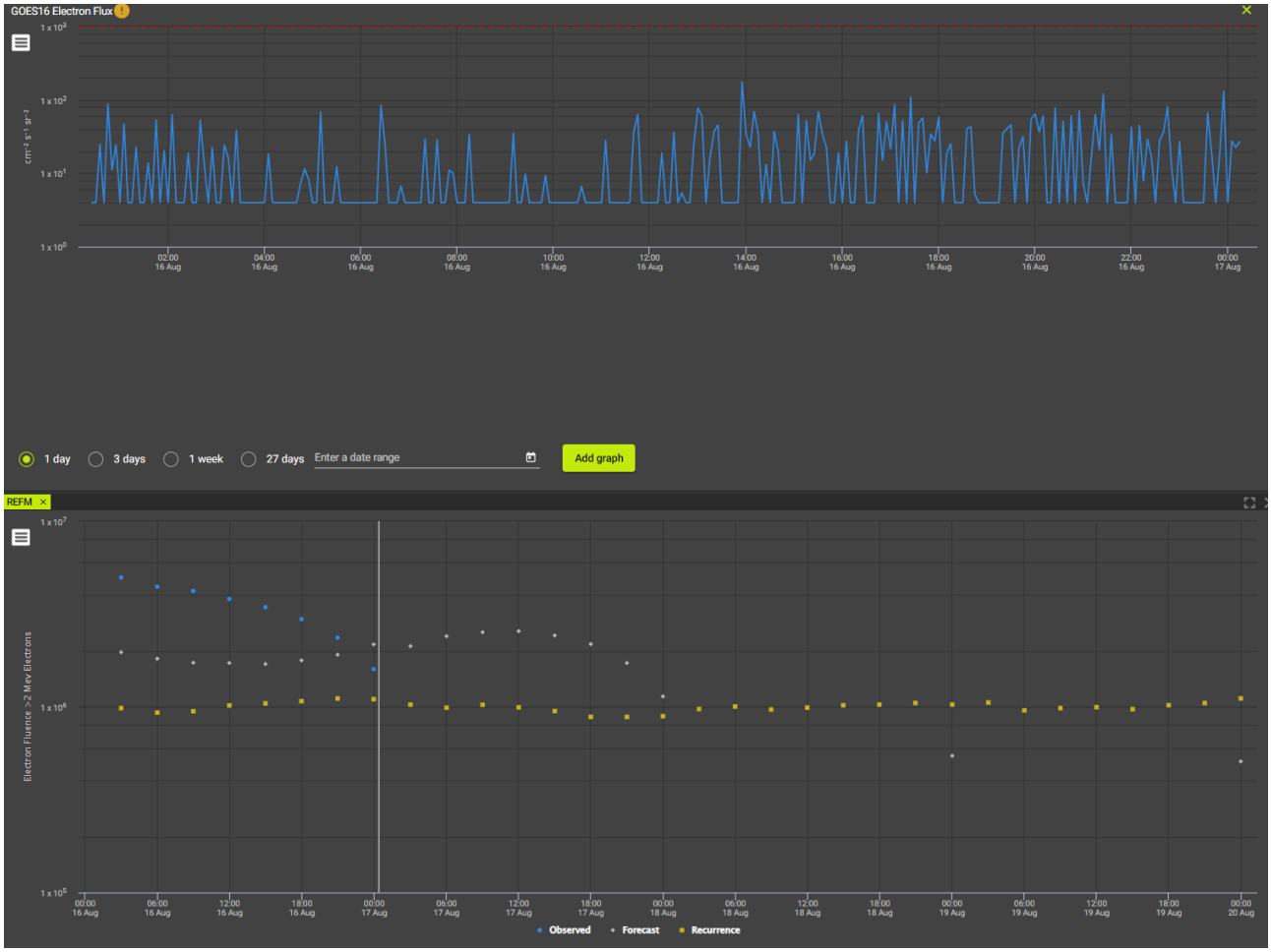
High Energy Electrons Event (≥ 2MeV):

High energy electron flux is expected to continue its current muted diurnal trend in the near-term, in the absence of any significant mechanisms to alter this state of affairs and with no coronal hole fast winds due in the four days. Confidence in the continuation of this behaviour in the wake of the X1.1 CME on Saturday 17 August should fall, perhaps giving an eventual Slight Chance of Active 24-hour fluence.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	5	10	10
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 5: 24 hour Electron trace and MOSWOC REFM fluence forecast, observations and recurrence.



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